

While the pipeline impacts could be considered temporary, the combined impacts associated with the reservoir and the pipelines will be a significant issue in the permitting processes. Impacts could result in opposition to any of the Whitney Creek Reservoir alternatives from wildlife groups, sportsmen, guides and outfitters, environmental groups and possibly the USFWS and CPW. Impacts to elk winter range could be a significant permitting risk factor, particularly for the three larger reservoir alternatives located on Homestake Creek.

DATE FILED: March 8, 2019 2:39 PM
FILED ID: 28E5E5A8EBDD
CASE NUMBER: 2018CW3126

Mitigation of potential impacts could include the enhancement of forage conditions in other winter range areas, enhanced restoration of the disturbed areas, and acquisition and protection of winter range located on private lands in the project vicinity. However, opportunities for these types of mitigation are limited in the project vicinity. Additional detailed investigations would be needed to determine if the available mitigation options would be sufficient to fully offset the impacts for each alternative. It may be more feasible to find effective mitigation opportunities for the smaller reservoir alternatives.

Bolts Lake

The Bolts lake option is located within overall deer range but would not affect deer winter range or migration corridors, as shown on **Figure C-21**.

Bolts Lake would be located in winter range, severe winter range, and winter concentration areas for elk, as shown on **Figure C-22**. This area is considered critical habitat for elk and the reservoir would permanently reduce the amount of critical winter range for elk by approximately 30 acres. Impacts to elk will be an important issue in the permitting process for Bolts Lake, but may not be a significant impediment to permitting if good mitigation options in the project vicinity can be identified.

Mitigation of potential impacts could include the enhancement of forage conditions in other winter range areas, enhanced restoration of the disturbed areas, and acquisition and protection of winter range located on private lands in the project vicinity. Additional detailed investigations would be needed to determine if the available mitigation options would be sufficient to fully offset the impacts. Because of the size of Bolt Lake is relatively small, it is more likely that the elk winter range impacts could be effectively offset with mitigation.

Wolcott Reservoir

Wolcott Reservoir would be located in deer overall range, severe winter range, winter concentration areas, migration corridors, and highway crossing routes, as shown on **Figure C-23**. This area is considered critical habitat for deer and is heavily used by deer for migration to and from summer concentration areas. Winter habitat is the critical limiting factor for the deer population in Eagle County. Wolcott Dam and Reservoir with 55,000 acre-feet of storage capacity would result in the permanent loss of over 600 acres of winter range and migration habitat for deer. The pipelines, including the Eagle River near Dowds Junction to Wolcott Reservoir and Eagle River near Alkali Creek to Wolcott Reservoir pipelines would be located mostly in existing utility and transportation corridors and would affect overall range for deer but would not significantly impact winter range. Impacts to migration associated

with the pipelines would be temporary and could be effectively mitigated with construction scheduling and reclamation of disturbed areas.

The impacts of Wolcott Reservoir to critical winter range and migration corridors for deer would be significant issues in the permitting processes. Impacts could result in opposition to the proposed project from wildlife groups, sportsmen, guides and outfitters, environmental groups and possibly the USFWS and CPW. Impacts to deer winter range could be a significant permitting risk factor.

Mitigation of potential impacts could include the enhancement of forage conditions in other winter range areas, enhanced restoration of the disturbed areas, and acquisition and protection of winter range located on private lands in the project vicinity. Additional detailed investigations would be needed to determine if the available mitigation options would be sufficient to fully offset the impacts.

Elk habitat that would be affected by Wolcott Reservoir is overall elk range, as shown on Figure C-24. The project would not adversely affect elk winter range or migration corridors. Mitigation may be required for impacts to elk habitat associated with the construction of the reservoir, but impacts to elk habitat should not be a significant permitting risk factor.

5.2.5 Threatened and Endangered Species

Endangered Species Act, Section 7 Consultation with the USFWS will be required in conjunction with federal permitting to proposed ERMOU projects. A preliminary evaluation of listed threatened and endangered species in the project area was conducted. **Table 5-6** below provides a list of the current federally listed threatened and endangered species that occur, or may occur, in Eagle County (USFWS, 2016). Species that are federally protected under the Endangered Species Act and listed as Endangered are in immediate threat of becoming extinct. Species listed as Threatened are those species likely to become endangered in the foreseeable future.

Table 5-6. Federally Listed Threatened and Endangered Species that may occur in Eagle County

Common Name Scientific Name	Status	Rational for Occurrence on Project Area (Habitat)
Bonytail chub <i>Gila elegans</i>	Endangered	Potential water depletions. (Colorado River below Rifle, Colorado)
Boreal toad <i>Anaxyrus boreas</i>	Under Review	Potential habitat. (Ponds with willow wetlands)
Canada lynx <i>Lynx canadensis</i>	Threatened	Potential forage and travel habitat. (Montane and subalpine forests)
Colorado pike minnow <i>Ptychocheilus lucius</i>	Endangered	Potential water depletions. (Colorado River below Rifle, Colorado)
Greenback Cutthroat Trout <i>Oncorhynchus clarki stomias</i>	Threatened	Potential water depletions.
Humpback chub <i>Gila cypha</i>	Endangered	Potential water depletions. (Colorado River below Rifle, Colorado)
Mexican Spotted Owl <i>Strix occidentalis lucida</i>	Threatened	No critical habitat designated in the project areas. (Old-growth or mature forests, canyons with riparian or conifer communities).
Razorback sucker <i>Xyrauchen texanus</i>	Endangered	Potential water depletions. (Colorado River below Rifle, Colorado)
Uncompahgre fritillary butterfly <i>Boloria acrocynema</i>	Endangered	No suitable habitat. (Snow willow stands above 12,000 feet up to 12,600 feet)
Ute ladies'-tresses <i>Spiranthes diluvialis</i>	Threatened	No suitable habitat. (Moist meadows between 4300-6850 feet)
Yellow-billed cuckoo <i>Coccyzus americanus</i>	Threatened	No suitable habitat. (Woodlands with cottonwoods and dense understory foliage)

The areas that would be affected by potential ERMOU projects, and the vicinity around the project area, do not include any designated critical habitat for any of the species listed in Table C-6, except for the critical habitat that has been designated for the four endangered Colorado River fish species. However, based upon an evaluation of the known geographical range and habitat requirements for the species list in **Table 5-6**, potentially suitable habitat was identified in the project areas for boreal toads (*Anaxyrus boreas boreas*) and Canada lynx (*Lynx Canadensis*). Section 7 consultation issues associated with these species are summarized below.

Colorado River Endangered Fish

The ERMOU project alternatives may affect the four Colorado River endangered fish species: Colorado pikeminnow (*Ptychocheilus lucius*); razorback sucker (*Xyrauchen texanus*); humpback chub (*Gila cypha*); bonytail chub (*Gila elegans*); and their designated critical habitat located downstream on the Colorado River. A primary concern of the USFWS will be the potential impact of water depletions associated with the ERMOU projects. Critical habitat has been designated for the four endangered fish species in the Colorado River near Grand Junction. The U.S. Fish and Wildlife Service (1999) has determined that activities resulting in water depletions in the Upper Colorado River Basin may jeopardize the continued existence of the four endangered fish.

A Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin was initiated in 1988. The Recovery Program was designed to be the reasonable and prudent alternative for individual projects to avoid the likelihood of jeopardy to the endangered fishes from water depletions

from the Upper Colorado River Basin. Under the terms of the Recovery Agreement, Section 7 Consultations on the water depletions are governed by the provisions of a Programmatic Biological Opinion issued by the USFWS on December 20, 1999. The Biological Opinion found that implementation of the Recovery Elements of the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin will avoid the likelihood of jeopardy and adverse modification for the cumulative impacts of historical depletions and up to 120,000 acre-feet of new depletions.

Additional investigations beyond the scope of this Study will be required to determine if the water depletions associated with the proposed ERMOU project would fall under the umbrella of the Recovery Program. Section 7 consultation requirements could depend upon whether the water depletions caused by the proposed ERMOU project would result in cumulative new depletions that exceed the 120,000 acre-feet covered by the Recovery Program and would be contingent upon periodic determinations by the USFWS that the Recovery Program is achieving sufficient progress toward recovery of the endangered fish species.

Boreal Toad

Species range maps for Boreal toads (*Lynx Canadensis*), available from the CPW Species Activity Mapping (SAM) study, were reviewed to identify potential ERMOU facilities that would be located within areas where boreal toads may occur. The boreal toad map information was last updated in December 2014 and is based on 2001-2006 site surveys. The Eagle Park Reservoir, Whitney Creek Reservoir, and Bolts Lake alternatives and associated pipelines and tunnels are all located within boreal toad overall range areas. Overall range is defined as the area which encompasses all known seasonal activity areas within the observed range of boreal toads. Boreal Toads are commonly found in mountain wetland areas and breed near water. Site-specific field surveys will be required for any proposed facilities that would be located in these areas.

The CPW maps show that the construction of Wolcott Reservoir will not impact boreal toad areas.

Canada Lynx

Species range maps for Canada lynx (*Lynx Canadensis*), available from the CPW Species Activity Mapping (SAM) study, were reviewed to identify potential ERMOU facilities that would be located within areas where Canada lynx may occur. The Canada lynx maps indicate that potential Lynx habitat areas include Eagle Park Reservoir, Whitney Creek Reservoir, and all the associated pipeline and tunnel options. Potential lynx habitat is defined as areas having the highest potential of lynx occurrences in the state. Canada lynx are specialized predators that are highly dependent on snowshoe hares for food. Lynx and snowshoe hare habitat is found in mature/old-growth spruce-fir coniferous forest and stands of dense lodgepole pine. Denning habitat for lynx is found in dense old-growth coniferous forest particularly in moist forest patches on north facing slopes. Lynx generally confine their travel movements to forested or densely wooded habitats and rarely venture far from cover, which provides forage opportunities and concealment from potential predators. Site-specific field surveys will be required for any proposed facilities that would be located in these areas. The CPW maps show that the construction of Bolts Lake, Wolcott Reservoir, and associated pipelines would not impact Lynx habitat.

5.2.6 Hydrology and Water Quality

Streamflows in the East Fork of the Eagle River, the Eagle River below the confluence of the East Fork, Homestake Creek, the Eagle River below the confluence of Homestake Creek, Peterson Creek, and Fall Creek would be affected by the operation of ERMOU facilities. Generally, water diversions for both East Slope and West Slope uses would occur primarily during spring runoff. Reservoir storage releases for East Slope uses could occur throughout the year and these releases would not accrue to local streams and rivers. Storage releases for West Slope consumptive and non-consumptive uses would occur primarily during the late summer, fall and winter and would accrue to the Eagle River and certain tributaries. In addition, exchanges to storage reservoirs located in the Upper Eagle River basin could occur in the early spring or mid-summer during periods when downstream calls of senior water rights occur concurrently with stream flows in the Eagle River Basin that are higher than Colorado Water Conservation Board (CWCB) instream flow water rights. All the proposed ERMOU project portfolios would be operated to limit water diversions sufficiently to satisfy CWCB instream flow water rights.

Streamflow changes, particularly those associated with peak stream flow reductions and exchanges of water to upstream diversion and storage facilities have the potential to impact aquatic habitat, riparian wetlands, water quality, and recreational boating. The potential Environmental and permitting issues associated streamflow changes are summarized below. Additional detailed investigations will be required to determine the significance of these issues and potential mitigation strategies. It is important to note that the hydrologic analysis included in this report was designed primarily to estimate the water supply yields of the project portfolios and does not include operational modifications that could potentially mitigate impacts associated with hydrologic modifications.

- Peak flow reductions could reduce scouring and flushing flows in the Eagle River below Resolution Creek and below Homestake Creek. Periodic flushing flows are beneficial to transport sediment downstream and maintain clean stream substrate for aquatic habitats for fish spawning, incubation, and macroinvertebrates.
- Reductions to the sediment transport capacity of the Eagle River downstream could be an important consideration in the 401 Certification process for assuring compliance with water quality standards. The portion of the Eagle River from Berry Creek has been added to the State's 303(d) List for sediment and aquatic life use.
- Streamflow reductions during the spring and early summer may affect stream hydraulics that help maintain overbank flooding and backwater conditions that support wetlands and aquatic habitat. Additional investigations will be needed to assess potential impacts.
- Certain downstream segments of the Eagle River have also been added to the 303(d) List for trace metals including arsenic, cadmium, and iron. The Eagle Mine Superfund Site located along the Eagle River above Minturn is the primary source of these and other pollutants that are highly toxic to aquatic life, including zinc and copper. Flow reductions could reduce dilution flows during the spring and early summer months, which would increase downstream concentrations of these pollutants. Reservoir releases could also increase dilution flows during certain times of the year and may serve to offset the impacts of flow reductions.

- Depending upon project operations and location on the river, the ERMOU alternatives could change streamflows that support recreational boating for fishing, kayaking and rafting. In some stream reaches, lower flows could diminish the excitement associated with white water boating and potentially reduce the length of the boating season, while in other stream reaches, reservoir releases and augmentation requirements may lengthen the boating season. Additional investigations will be needed to assess potential impacts.
- Studies conducted downstream on the Eagle River below Gore Creek over the last several years have identified concerns with water temperature in the Eagle River below Gore Creek. Flow changes from reservoir operations could adversely or beneficially affect water temperature depending on location and time of year. Detailed temperature modelling may be required to assess potential temperature and aquatic life impacts.

Issues associated with streamflow changes and water quality summarized above will be of critical importance during permitting processes. Detailed investigations beyond the scope of this project will be required prior to permitting to further investigate potential impacts and develop mitigation strategies.

Section 6 Next Steps

The ERMOU Technical Advisors request ERMOU stakeholder review, comments, and discussion on the content and results of this Study and on the timing of and commitment to ERMOU project development. Should the ERMOU Partners elect to further evaluate specific project components presented in this report, the ERMOU Technical Advisors believe that collection of additional data and completion of additional evaluations, as summarized below, would significantly improve the reliability of the evaluations presented in this report. Next steps described below should be carefully coordinated between each technical discipline and with consideration for legal, economic, and institutional issues.

6.1 Engineering and Costs

Next steps for evaluating dam and reservoir facilities would generally include obtaining additional data and performing more refined engineering analyses. The expected level of effort would vary from site to site and by type of facility. A description of next steps by site is presented below.

Eagle Park Reservoir

1. Obtain suitable topography.
2. Perform geologic mapping.
3. Perform geotechnical investigations and possibly geophysical evaluations at the existing dam and foundation areas for new dam.
4. Perform seepage analyses to refine the need and extent of foundation treatments and seepage and stability analyses to refine the cross section for the dam enlargement.
5. Perform geotechnical investigations at potential borrow areas.

Whitney Creek Reservoir

1. Perform a more detailed hydrologic evaluation to better define the inflow design flood (IDF).
2. Perform geotechnical investigations to investigate the foundation conditions along the dam alignment and at the spillway and to obtain data to improve the interpretation of the previous geophysical study. The ERMOU Partners are currently working with the USFS to obtain a permit to possibly perform this work in the summer of 2016.
3. Perform seepage analyses to refine the need and extent of foundation treatments and seepage and stability analyses to refine the cross section of the dam.
4. Perform additional research to evaluate steps required to possibly realign Homestake Road through the Roadless Area and Wilderness Area.
5. Continue to coordinate with the USFS regarding adjusting the Holy Cross Wilderness Area boundary in the immediate vicinity of the dam and reservoir.
6. Perform a siting study of off-channel reservoir alternatives.

Bolts Lake

1. Obtain suitable topography.
2. Perform a preliminary hazard classification analyses.
3. Collect and review available groundwater data from the site vicinity.
4. Define design criteria related to impacts to the natural groundwater and surrounding superfund sites.

5. Perform groundwater modeling to evaluate how a reservoir liner would impact the existing groundwater flow regime.
6. Perform analyses to refine the embankment geometry.
7. Develop a grading plan to identify if embankment materials could be obtained from on-site materials or if embankment materials would need to be imported.
8. Develop concepts for the outlet works and spillway.

Wolcott Reservoir

1. Obtain suitable topography.
2. Perform a hydrologic evaluation to define the inflow design flood (IDF).
3. Perform geologic mapping.
4. Perform geotechnical investigations in embankment foundation and potential borrow areas.
5. Perform seepage analyses to refine the need and extent of foundation treatments and seepage and stability analyses to refine the cross section of the dam.
6. Develop concepts for the outlet works and spillway.
7. Develop a concept and preliminary alignment for Highway 131 realignment.

Next steps for evaluating conveyance facilities would involve a) identifying land ownership and/or easement needs and corresponding potential acquisition costs and b) performing optimization of the hydraulic facilities to better identify pump and pipeline sizes. Most of the conveyance facilities would be located on property not currently owned by the ERMOU Partners. In some cases, it may be beneficial to acquire property (e.g. from private land owners). A significant portion of the conveyance facilities would also extend through USFS property, where easements are expected to be required for these corridors.

It would also be beneficial to perform optimization of the conveyance facilities to better identify pump and pipeline sizes. For example, smaller pipelines reduce pipeline costs but would also increase frictional head losses and result in larger pumps and higher O&M costs. For selected conveyance facilities, it is anticipated that developing several alternatives with different combinations of pipe and pump sizes to identify preferred configurations. It would also be beneficial to coordinate with pump manufacturers to discuss different pump types and configurations that may be beneficial for various project components. Power costs for pumping are expected to be the primary component of variable O&M costs, which in turn, are expected to greatly influence viability of ERMOU project alternatives. More detailed evaluations of pumping power needs are recommended for preferred ERMOU project alternatives.

6.2 Water Supply and Project Yield

Next steps for water supply and project yield evaluations include refinement of analysis tools (e.g. daily simulation model) and more refined analyses to support and inform next steps identified for the engineering and environmental disciplines. Next steps would consider more refined project alternatives as specific Partner objectives and potential project constraints are identified. Corresponding evaluations would include use of more refined information associated with ERMOU objectives, project demands, legal water availability, operational constraints, and potential integration with existing supply systems. A list of possible evaluations is presented below.

1. Legal availability of water (e.g. use of conditional rights)
2. Variations in ERMOU project capacities (e.g. Whitney Creek Reservoir)
3. Updated and future demand patterns (e.g. Partner demand projections)
4. Operational constraints for integrated water facilities (e.g. Homestake system)
5. Variations in yield/storage objectives (e.g. ratios of ERMOU Partner objectives)
6. Considerations for integrated water supplies (e.g. other East and West Slope supplies)
7. Refined quantitative hydrologic and water quality evaluations (e.g. environmental impacts)
8. How East Slope system constraints could impact yields and what additional infrastructure or operational changes are required to achieve full ERMOU East Slope yields

6.3 Environmental Requirements and Issues

The potential permitting issues addressed in this report would all require further site specific investigations to fully understand the extent of the potential adverse and beneficial impacts, the possibilities for modifications of project facilities and operations to avoid and minimize adverse impacts, and to identify mitigation strategies. These investigations should be carefully coordinated with other studies related to project engineering, operational, and economic considerations. Such investigations should include the following:

1. Consultation with local stakeholders, including governmental entities, should occur early in the planning process to further identify issues and concerns that will need to be addressed.
2. Additional work is needed to clearly document both the East Slope and West Slope purposes and needs for development of the ERMOU projects and the potential timing of such needs. This information will be critical for framing discussions with stakeholders and permitting agencies.
3. Project operations should be further refined to address potential issues associated with peak flows and water quality. Operational refinements could influence the siting and configuration of diversion and pumping facilities and upstream reservoir storage requirements.
4. The presence or absence of fen wetlands, and the possible extent of fen wetlands, at the potential sites for the Whitney Creek Reservoir alternatives could be an important permitting risk factor and should be further investigated prior to site selection.
5. Continued coordination with USFS on the pending SF-299 permit application (Application for Transportation and Utility Systems and Facilities on Federal Lands) to proceed with subsurface explorations associated with the Whitney Creek Reservoir alternatives.
6. Class III cultural resource and bird nesting field surveys described in the pending SF-299 permit application associated with the Whitney Creek Reservoir alternatives.
7. Public outreach to proceed with subsurface explorations described in the pending SF-299 permit application associated with the Whitney Creek Reservoir alternatives.
8. Continued coordination with National Forest Foundation (NFF) and US Forest Service (USFS) on Camp Hale Wetland Reconstruction activities.
9. Continued coordination with the USFS in consideration for potential adjustments to the Holy Cross Wilderness Boundary.

Section 7 References

The following references were reviewed to support feasibility-level evaluations.

7.1 Engineering and Costs

Eagle Park Reservoir

- Brown and Caldwell (2005). Feasibility Study Eagle Park Reservoir Enlargement.
- Black and Veatch (2009). Camp Hale to Eagle Park Reservoir Water Delivery System.
- Meuer, Serafini and Meurer, Inc. and Woodward-Clyde-Sherard & Associates (1964). Dam No. 4.
- W.W. Wheeler and Associates (1994). Eagle Park Reservoir Outlet Works Project.
- W.W. Wheeler and Associates (1996). No. 4 Dam Seepage System Pump Station Modification and Return Pipeline.
- W.W. Wheeler and Associates (1998). Eagle Park Reservoir Outfall Improvements and Flume House.
- Brown and Caldwell. (2006). Eagle Park Reservoir Dam Spillway Modifications.
- Brown and Caldwell. (2006). Eagle Park Reservoir Dam East Fork Pump Station.
- Stantec, Inc. (2009). Eagle Park Reservoir Dam Spillway Modifications.
- Stantec, Inc. (2010). Eagle Park Reservoir Dam Spillway Additional Modifications.

Whitney Creek Reservoir

- Black and Veatch (2012). Eagle River Drainage Basin Diversion Project.
- Grand River Consulting and RJH Consultants (2014). Preliminary Evaluation – Lower Homestake Creek Reservoir Sites.
- RJH Consultants (2015). Whitney Creek Phase I Investigation.

Bolts Lake

- Applegate Group, Inc. (2010). Bolts Lake Engineering Review – Battle Mountain Project.
- Applegate Group, Inc. (2010). Diversion Structure Engineering Review – Battle Mountain Project.
- 8140 Partners, LLC. (2011). Feasibility-Level Liner Design Assessment Memorandum, Proposed Bolts Lake Reservoir.
- Shannon and Wilson, Inc. (2011). Geotechnical Data Report – Bolts Lake Reservoir.
- 8140 Partners, LLC. (2012). Battle Mountain Project Bolts Lake Reservoir Liner Design Plans. These plans consist of approximately 30-percent design drawings for dam and reservoir liner. The preferred liner concept consists of a geocomposite clay liner.

Wolcott Reservoir

- Grand River Consulting. (2004). Wolcott Reservoir Feasibility Assessment – Phase I Investigation.
- Western Engineers, Inc. (1987). 1986 Development Work for the Wolcott and Red Cliff Projects.

7.2 Water Supply and Project Yield

Eagle Park Reservoir

- W.W. Wheeler and Associates, Inc. (1993). Eagle Park Reservoir – Preliminary Engineering Analysis – Revised.
- Helton & Williamsen, P.C. (1995). Eagle Park Reservoir Project – Simulations of Project Yield.
- Helton & Williamsen, P.C. (1997). Eagle Park Reservoir Project – Feasibility Report.
- Helton & Williamsen, P.C. (1999). Plan for Augmentation Involving Eagle Park Reservoir – Case No. 98CW204.
- Helton & Williamsen, P.C. (1999). Plan for Augmentation Involving Eagle Park Reservoir – Case No. 98CW205.
- Helton & Williamsen, P.C. (2014). Enlargement of Eagle Park Reservoir.
- Helton & Williamsen, P.C. (2014). Eagle Park Reservoir Enlargement – Additional Yield Calculations.

Whitney Creek Reservoir

- Black and Veatch Corporation (2012). Eagle River Drainage Basin Diversion Projects.
- Grand River Consulting Corporation (2013). Water Yield Estimates for Homestake Project Expansion Options.

Bolts Lake

- Applegate Group, Inc. (2010). Bolts Lake Engineering Review – Battle Mountain Project.
- Applegate Group, Inc. (2010). Diversion Structure Engineering Review – Town of Minturn and Battle Mountain Project.

Wolcott Reservoir

- Grand River Consulting Corp, GEI Consultants. (2004). Wolcott Reservoir Feasibility Assessment.

Piney River Reservoir

- Brown and Caldwell (2000). An Evaluation of the Eagle-Piney/Eagle-Colorado Reconfiguration Alternatives.

Iron Mountain Reservoir

- Enartech, Inc. (1990). Iron Mountain Reservoir Project – Pre-Feasibility Assessment.
- Ueblacker Associates (1995). Upper Eagle River Reservoir Study – Reconnaissance Level Geologic Evaluation of Dam Sites.
- Colorado River Water Conservation District (2010). Memorandum – Red Cliff Project Development.

Eagle-Arkansas Ditch

- Black and Veatch Corporation (2012). Eagle River Drainage Basin Diversion Projects.
- Grand River Consulting Corporation (2013). Water Yield Estimates for Homestake Project Expansion Options.

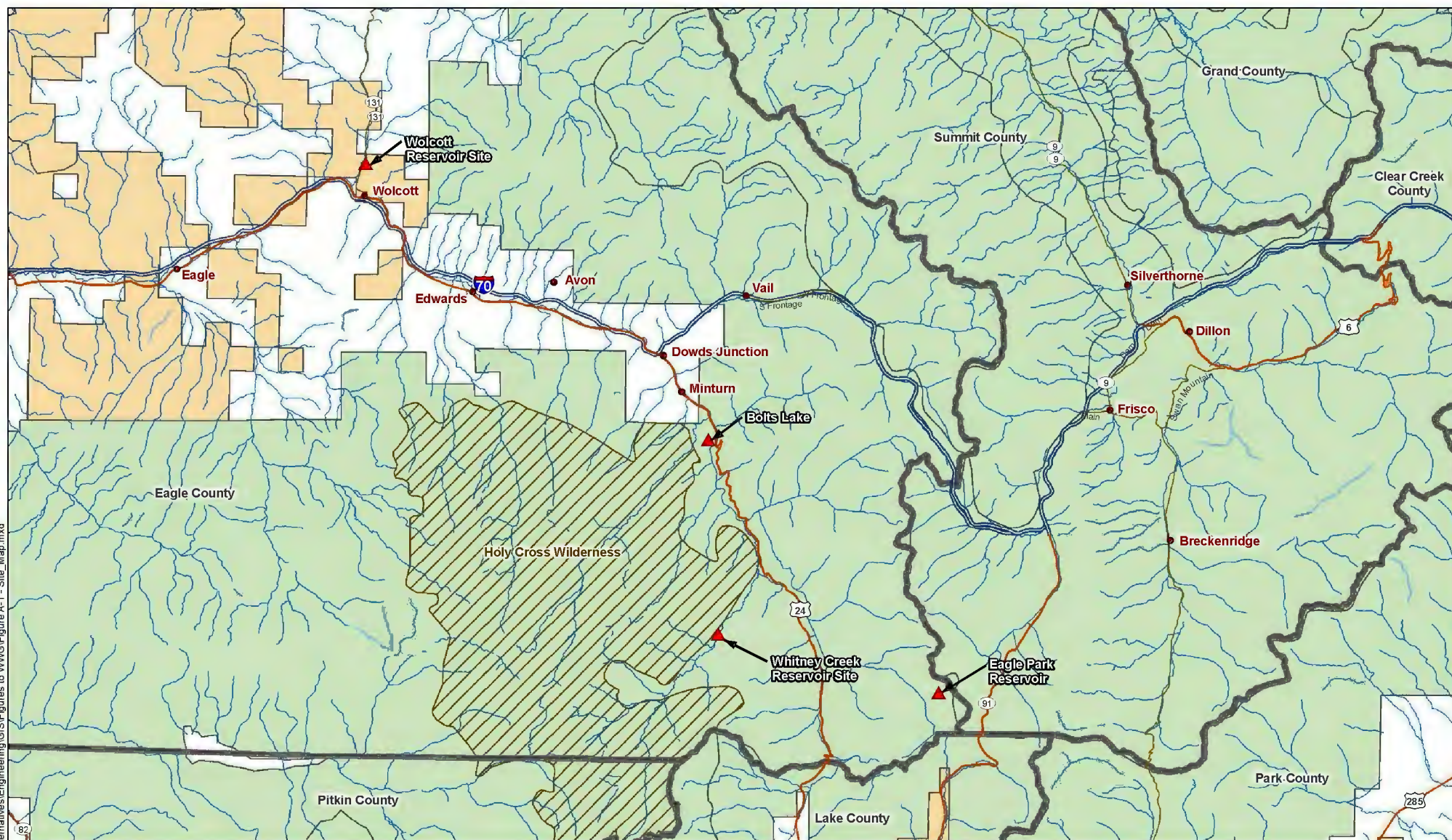
7.3 Environmental Requirements and Issues

- 8140 Partners, LLC and Claffey Ecological Consulting, Inc. (2011). Bolts Lake Reservoir – Wetlands Alternatives Analysis.
- Colorado Parks and Wildlife (2015). GIS Species Activity Mapping Definitions: Colorado Department of Natural Resources.
- ERO Resources Corporation (1997). Preliminary Environmental Review of the Upper Eagle River Project: prepared for the Upper Eagle River Project Participants.
- USDA Forest Service (2002). Land and Resource Management Plan, White River National Forest.
- U.S. Fish and Wildlife Service (2015). Wetland Mapper Documentation and Instruction Manual: Division of Habitat and Resource Conservation Branch of Resource and Mapping Support.
- U.S. Fish and Wildlife Service (2016). National Wetlands Inventory Wetlands Mapper: <http://www.fws.gov/wetlands/Data/Mapper.html>.
- Colorado Department of Natural Resources, Colorado Water Conservation Board, Rules Concerning the Colorado Instream Flow and Natural Lake Level Program (2 CCR 408-2).
- National Forest Foundation (2014). Camp Hale – Eagle River Headwaters Restoration Project: Collaborative Recommendations for Restoration and Management. <https://www.nationalforests.org/who-we-are/our-impact/whiteriver>
- U.S. Department of the Interior, Fish and Wildlife Service (1999). Final Programmatic Biological Opinion for Bureau of Reclamation's Operations and Depletions, Other Depletions, and Funding and Implementation of Recovery Program Actions in the Upper Colorado River above the Confluence with the Gunnison River.

Section 8 Appendices

Appendix A: Engineering and Costs

P:\15126-ERMou Alternatives\Engineering\GIS\Figures to WWG\Figure A-1 - Site Map.mxd



Legend

- Forest Service
- Bureau of Land Management

- ERMou Sites
- Counties

**THIS DOCUMENT MUST
BE REPRODUCED IN COLOR**

0 10,000 20,000 40,000
Feet

DRAFT



EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

PROJECT NUMBER 15126


SITE LOCATION MAP

April 2016

Figure A-1

P:\15126-ERMOU Alternatives\Engineering\GIS\Figures to WVG\Figure A-2 Eagle Park.mxd



 Roadless Area

**THIS DOCUMENT MUST
BE REPRODUCED IN COLOR**

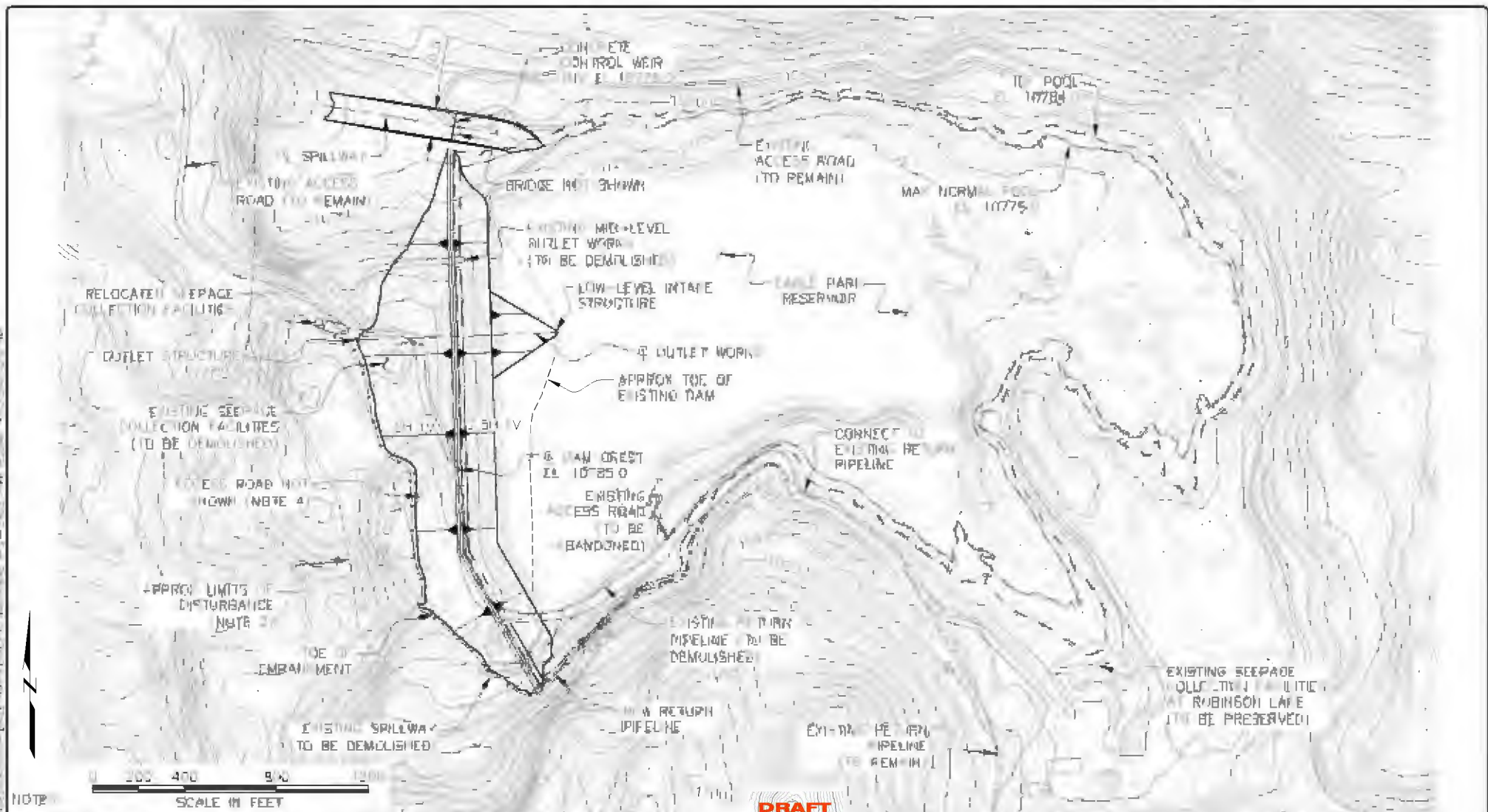


EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

PROJECT NUMBER 15126

GENERAL PLAN OF
EAGLE PARK RESERVOIR
FACILITIES

April 2016 **Figure A-2**



NOTE:

SCALE IN FEET

- 1 TOPOGRAPHY DEVELOPED FROM 2-METER DIGITAL ELEVATION MAP BASED ON 1994 DATA DEVELOPED BY SKI RESEARCH (2001)
- 2 APPROXIMATE LIMITS OF DISTURBANCE ALSO INCLUDED ALL AREAS BELOW THE ENLARGED MAXIMUM NORMAL RESERVOIR POOL
- 3 CONVEYANCE FACILITIES NOT SHOWN
- 4 ACCESS ROAD FROM CREST TO SEEPAGE COLLECTION FACILITIES ALONG DOWNSTREAM TOE

DRAFT



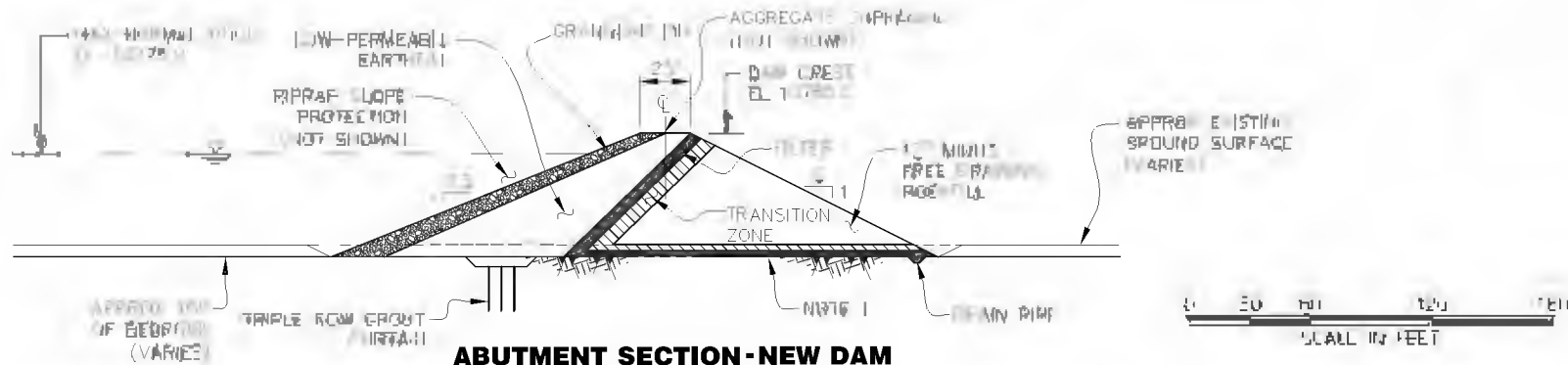
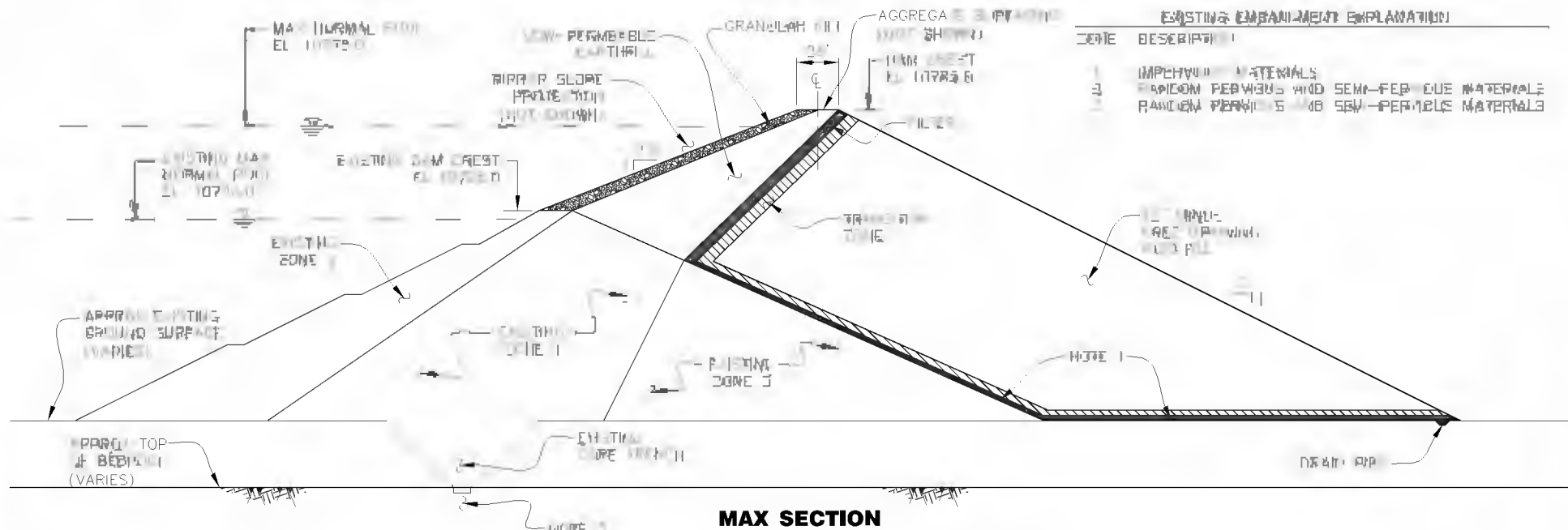
EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

PLAN OF
EAGLE PARK RESERVOIR
MODIFICATIONS

PROJECT NO. 15126

April 2016

Figure A-3



DRAFT

NOTES

1. STRIP EXISTING GROUND SURFACE AND DOWNSTREAM EMBANKMENT TO BE NEW FILL INTO EXISTING MATERIALS.
2. EXISTING EMBANKMENT AND FOUNDATION CONDITIONS ARE BASED ON 1/4"=1'-0" SHOWN ON THE 1964 AS-BUILT DRAWINGS.
3. THE NEED FOR FOUNDATION TREATMENT BELOW EXISTING DAM IS UNKNOWN.



EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

EAGLE PARK
RESERVOIR
TYPICAL SECTIONS



PROJECT NO. 15126

April 2016

Figure A-4

P:\15126-ERM\OU Alternatives\Engineering\GIS\Figures to WVG\Figure A-5 Borrow Areas.mxd



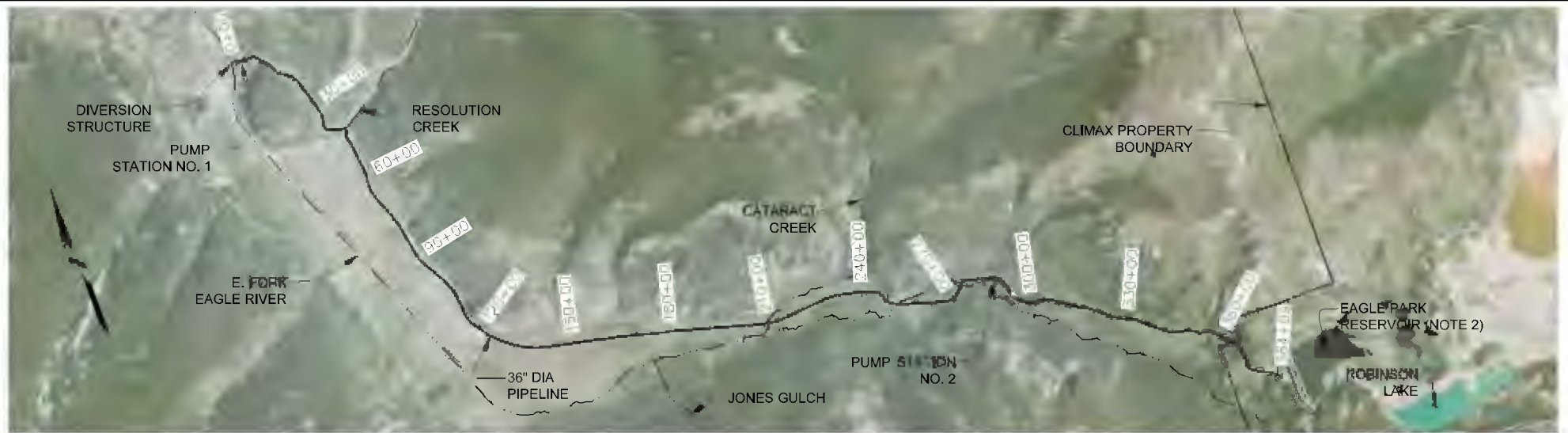
-  Borrow Areas
-  Roadless Area

**THIS DOCUMENT MUST
BE REPRODUCED IN COLOR**



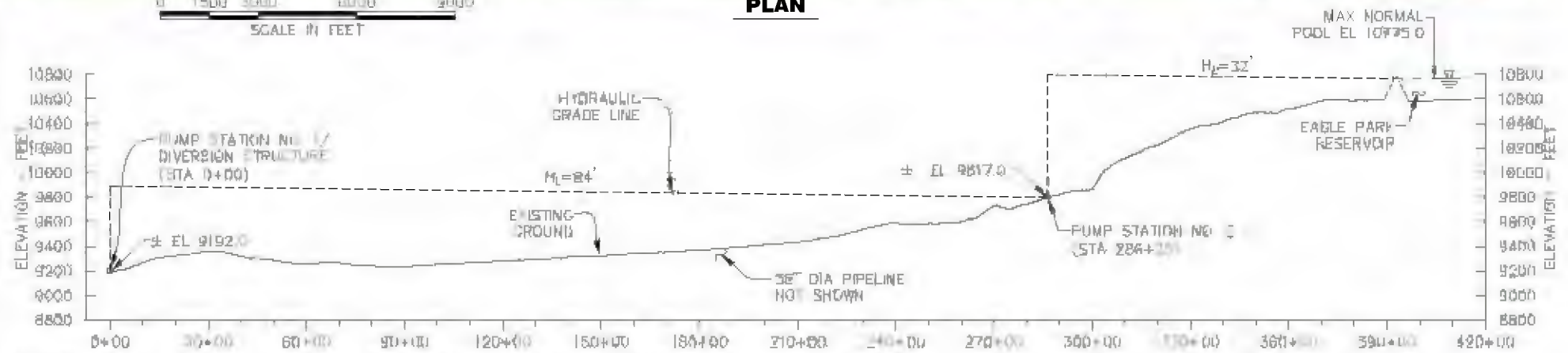
EAGLE RIVER MOU PROJECT ALTERNATIVES STUDY - PHASE 2	PLAN OF POTENTIAL BORROW AREAS
PROJECT NUMBER 15126	April 2016 Figure A-5

P:\15126-ERMCO ALTERNATIVES\1501001- EAGLE PARK\FIGURES TO MW\FIGURE A-6 HYDRAULIC SCHEMATIC.DWG 4/15/2016 10:10 AM



0 1500 3000 4500 6000
SCALE IN FEET

PLAN



0 1500 3000 4500 6000 7500
SCALE IN FEET HORIZONTAL

0 400 800 1200 1600 2000
SCALE IN FEET VERTICAL

HYDRAULIC PROFILE

DRAFT

NOTES

- EXISTING GROUND TOPOGRAPHY DEVELOPED FROM 2-METER DIGITAL ELEVATION MAP BASED ON LIDAR DATA DEVELOPED BY SKI RESEARCH (2002)
- PIPELINE OUTFALL ALONG DAM NOT SHOWN
- PIPELINE ALIGNMENT AND HYDRAULIC PROFILE FROM BLACK AND VEATCH CAMP HALE TO EAGLE PARK RESERVOIR WATER DELIVERY SYSTEM REPORT (2009)



EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

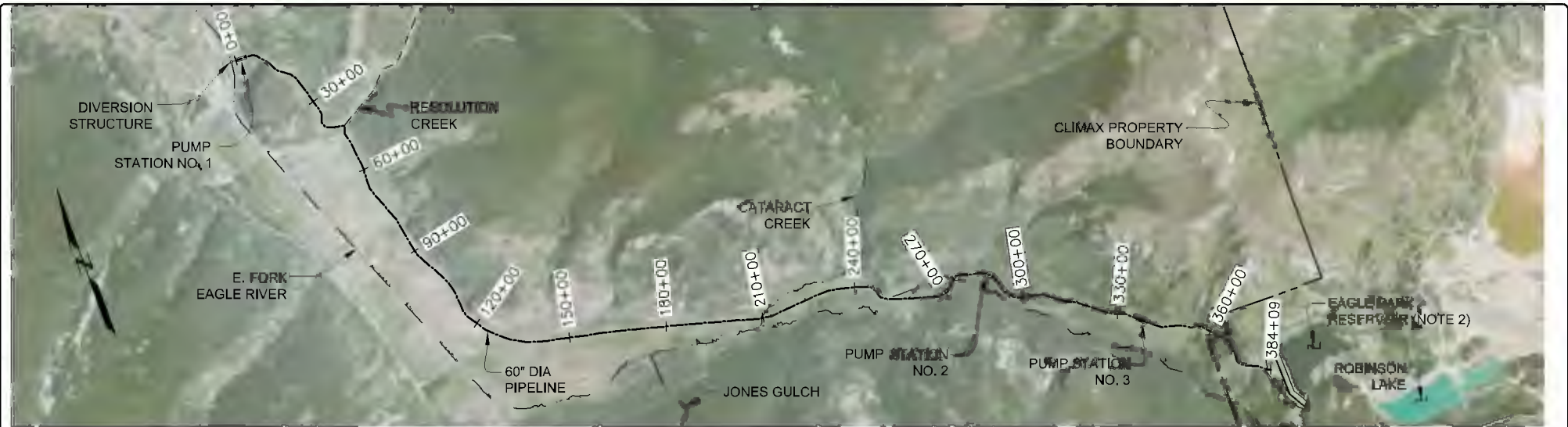
PROJECT NO. 15126

CONVEYANCE FACILITIES FROM
CAMP HALE TO
EAGLE PARK RESERVOIR 40 CFS-
PLAN AND HYDRAULIC PROFILE

April 2016

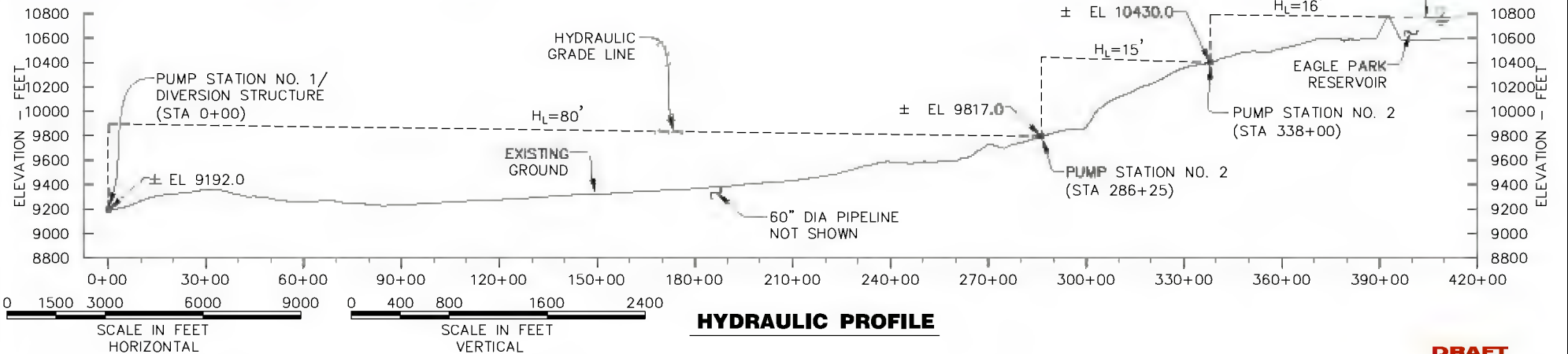
Figure A-6

P:\15126-ERNIVU ALTERNATIVES\15126-ERNIVU-ALTERNATIVES TO WWST\FIGURE 3 - HYDRAULIC SCHEMATIC.DWG 4/15/2016 10:11 AM



0 1500 3000 6000 9000
SCALE IN FEET

PLAN



HYDRAULIC PROFILE

DRAFT

NOTES:

1. EXISTING GROUND TOPOGRAPHY DEVELOPED FROM 2-METER DIGITAL ELEVATION MAP BASED ON LIDAR DATA DEVELOPED BY SKY RESEARCH (2002).
2. PIPELINE OUTFALL ALONG DAM NOT SHOWN.
3. PIPELINE ALIGNMENT AND HYDRAULIC PROFILE FROM BLACK AND VEATCH CAMP HALE TO EAGLE PARK RESERVOIR WATER DELIVERY SYSTEM REPORT (2009).



EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

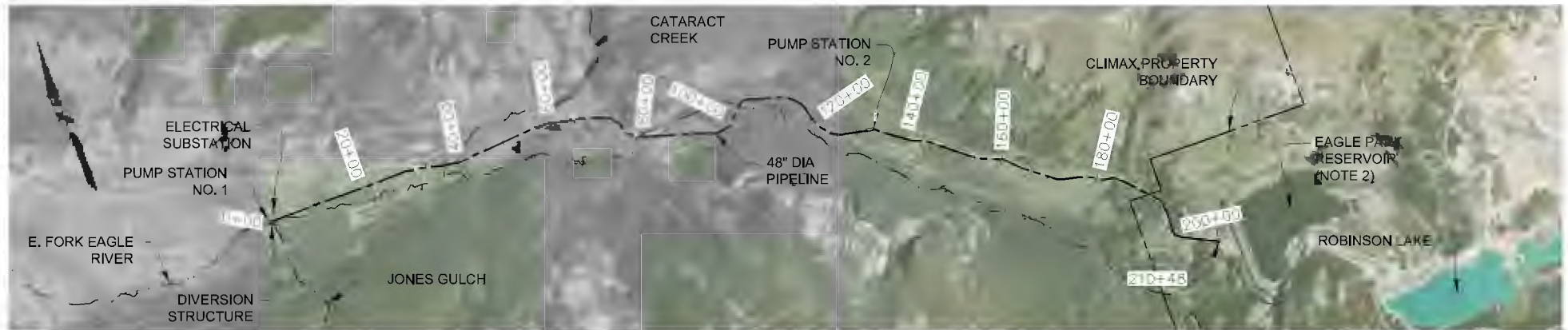
PROJECT NO. 15126

CONVEYANCE FACILITIES FROM
CAMP HALE TO
EAGLE PARK RESERVOIR 150 CFS-
PLAN AND HYDRAULIC PROFILE

April 2016

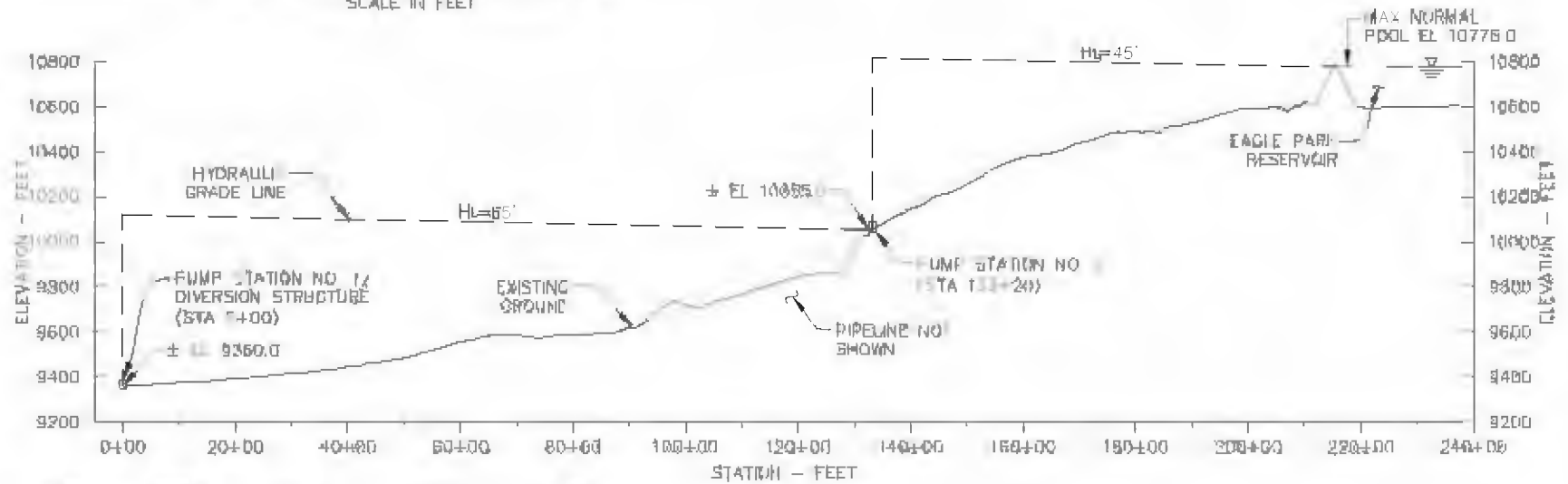
Figure A-7

P:\15126-ERNOW ALTERNATIVES\A-1\1001- EAGLE PARK\FIGURES TO WWS\FIGURE A-8 HYDRAULIC SCHEMATIC.DWG 4/15/2016 10:12 AM



0 1000 2000 4000 6000
SCALE IN FEET

PLAN



0 1000 2000 4000 6000
SCALE IN FEET
HORIZONTAL

0 250 500 1000 1500
SCALE IN FEET
VERTICAL

HYDRAULIC PROFILE

DRAFT

NOTES

1. EXISTING GROUND TOPOGRAPHY DEVELOPED FROM 3-METER DIGITAL ELEVATION MAP BASED ON LIDAR DATA DEVELOPED BY 3I RESEARCH (2003)
2. PIPELINE OUTFALL ALONG DAM NOT SHOWN



EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

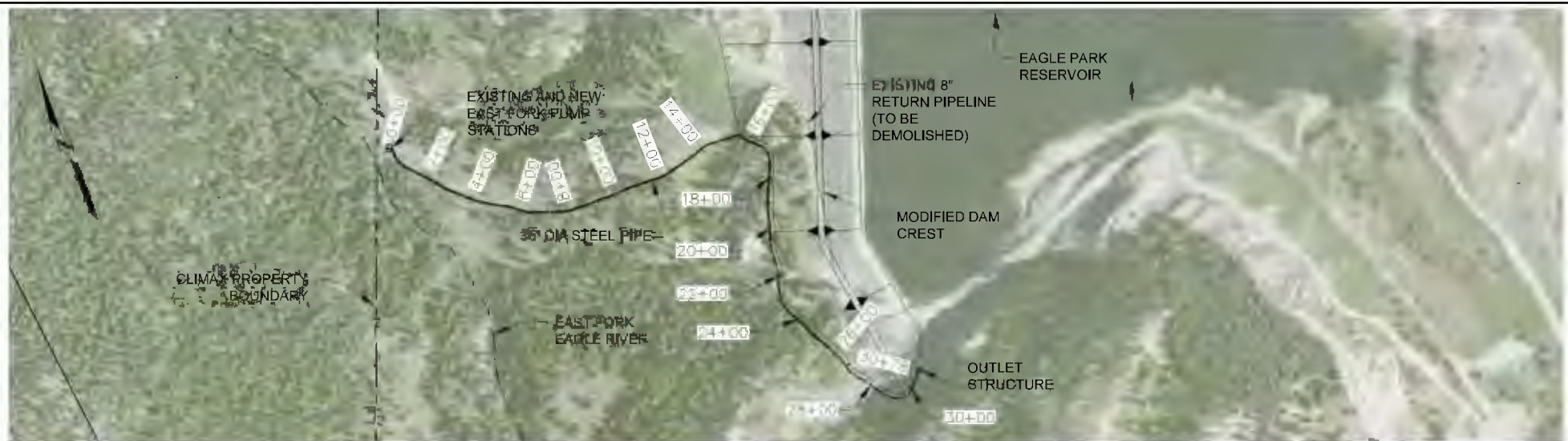
PROJECT NO. 15126

CONVEYANCE FACILITIES FROM
NEAR JONES GULCH TO
EAGLE PARK RESERVOIR -
PLAN AND HYDRAULIC PROFILE

April 2016

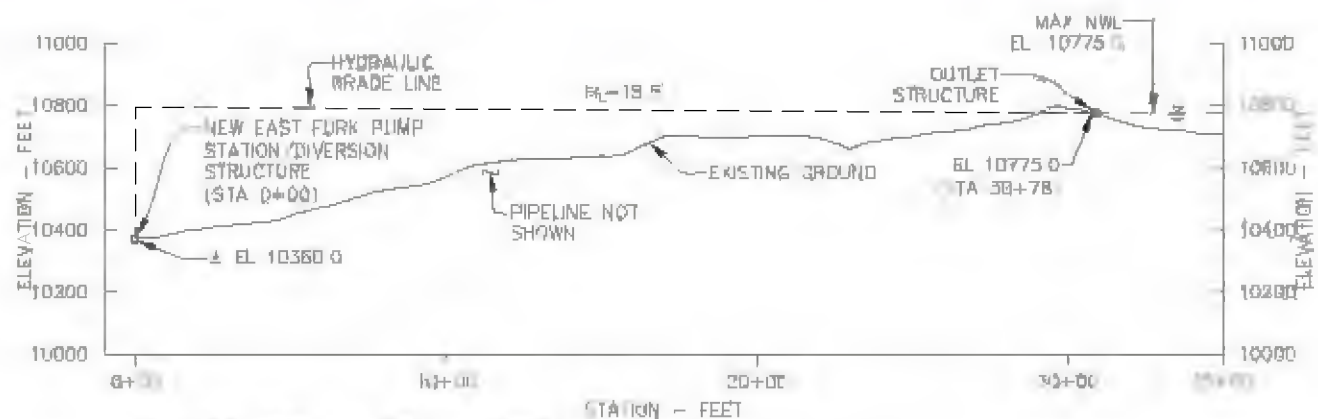
Figure A-8

P:\15126-ERNR-ALTERNATIVES\CAO\1001- EAGLE PARK FIGURES TO MW\Figure A-9 - EAST FORK P.S.DWG 4.15.2016 10:13 AM



0 200 400 600 800
SCALE IN FEET

PLAN



0 200 400 600 800
SCALE IN FEET

HYDRAULIC PROFILE

DRAFT

NOTES

- EXISTING GROUND TOPOGRAPHY DEVELOPED FROM 2-METER DIGITAL ELEVATION MAP BASED ON LIDAR DATA DEVELOPED BY SKI RESEARCH (2002)



EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

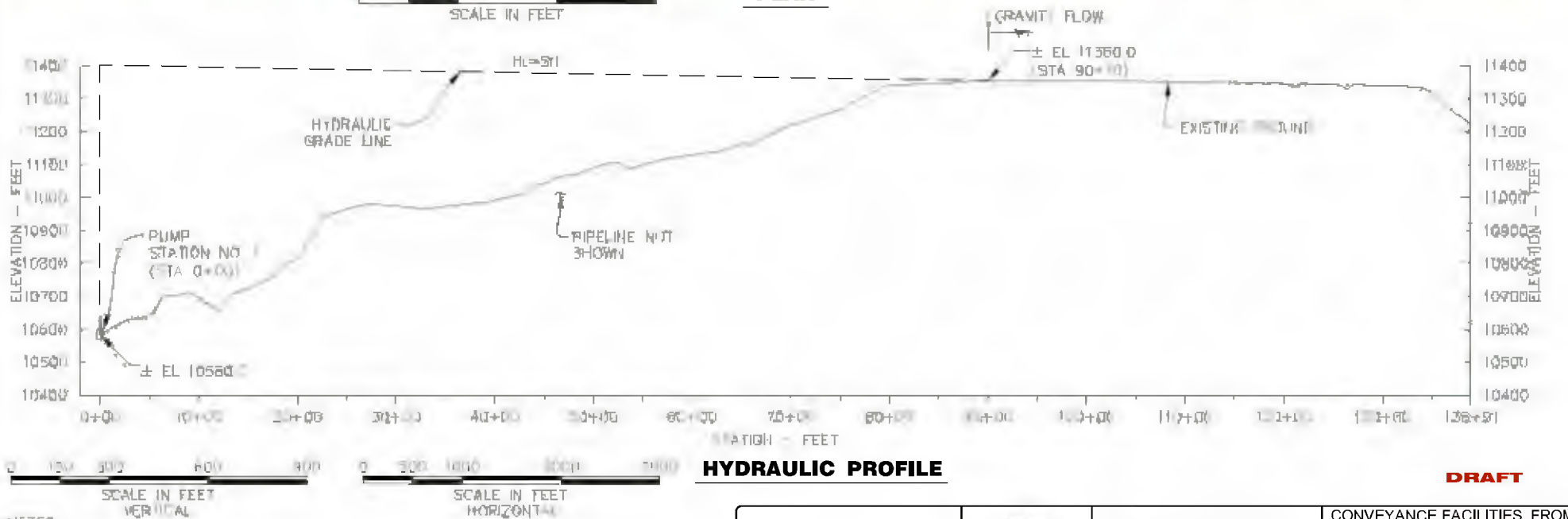
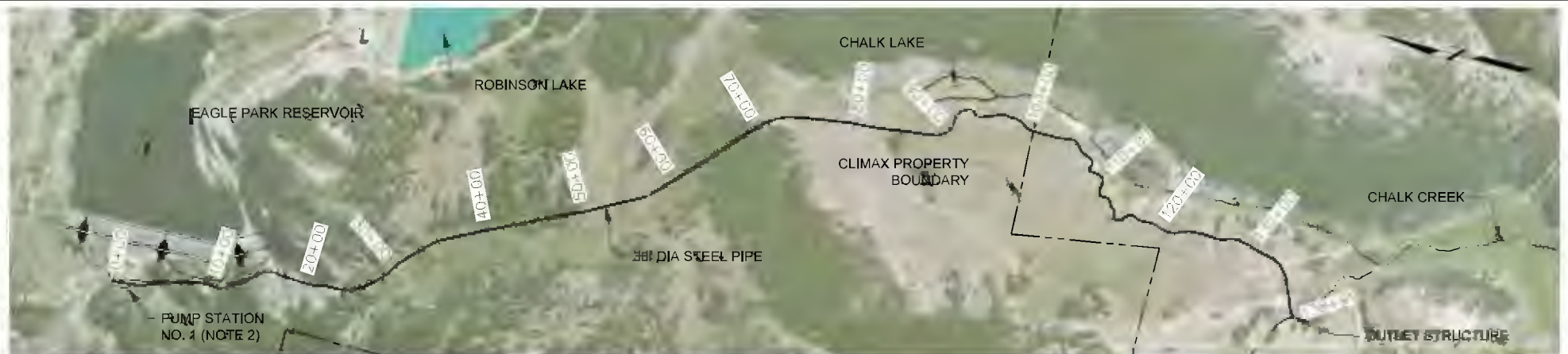
PROJECT NO. 15126

CONVEYANCE FACILITIES TO
EAGLE PARK RESERVOIR FROM
EXISTING PUMP STATION -
PLAN AND HYDRAULIC PROFILE

April 2016

Figure A-9

P:\15126-ERNRIV ALTERNATIVES\2401000- EAGLE PARK\FIGURES TO WWS\FIGURE A-10 EPR TO CHALK CREEK.DWG 4/15/2016 10:14 AM



DRAFT

NOTES

1. EXISTING GROUND TOPOGRAPHY DEVELOPED FROM 2-METER DIGITAL ELEVATION MAP BASED ON LIDAR DATA DEVELOPED BY SKY RESEARCH (2002)
2. PUMP STATION CONNECTION TO OUTLET WORKS NOT SHOWN



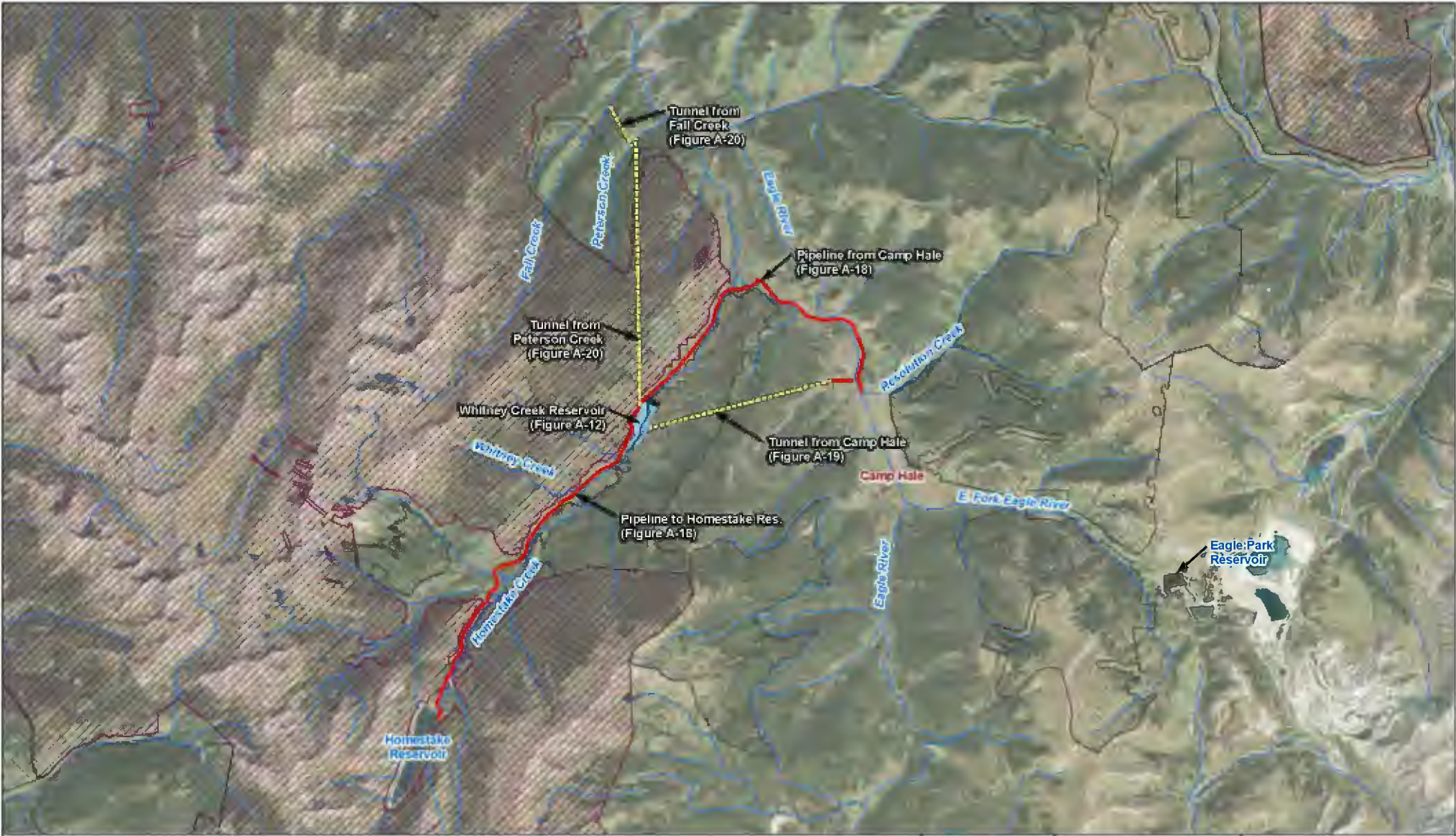
EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2




PROJECT NO. 15126

CONVEYANCE FACILITIES FROM
EAGLE PARK RESERVOIR TO
CHALK CREEK -
PLAN AND HYDRAULIC PROFILE

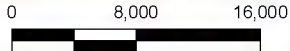
April 2016

Figure A-10



- | | |
|---|---|
|  Pipeline |  Roadless Area |
|  Tunnel |  Wilderness Boundary |

**THIS DOCUMENT MUST
BE REPRODUCED IN COLOR**



DRAFT



EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

PROJECT NUMBER 15126

PLAN OF
WHITNEY CREEK RESERVOIR
FACILITIES

April 2016

Figure A-11

P:\15126-ERMCU-ALTERNATIVES\AD\1002-WHITNEY CREEK\FIGURES TO WW\15126 FIGURE A-12 - PLAN OF SITES.DWG 4/15/2016 10:35 AM



DRAFT

0 750 1500 3000 6000
SCALE IN FEET



EAGLE RIVER MOU PROJECT
ALTERNATIVES PHASE 2 -
STUDY

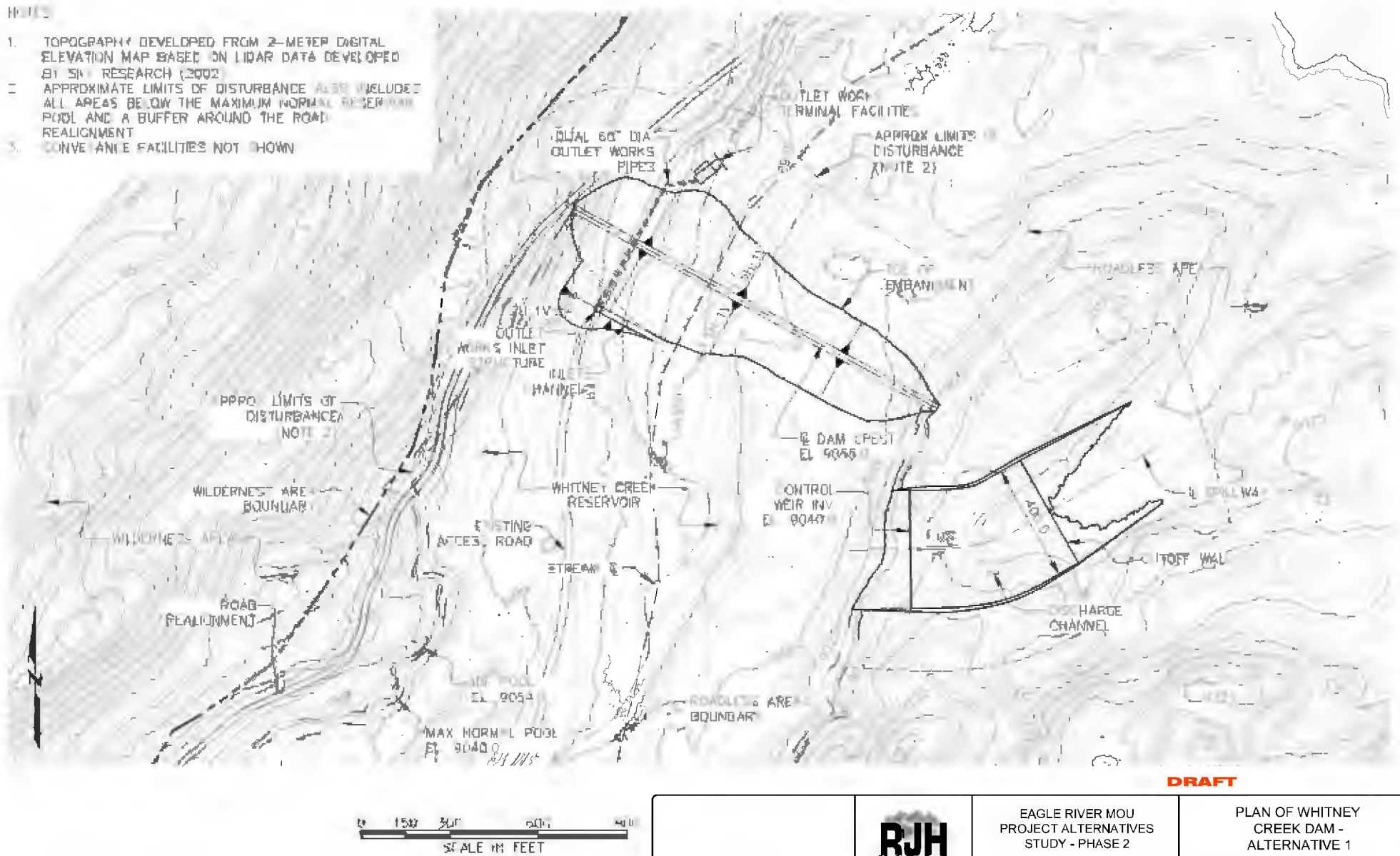
PLAN OF WHITNEY
CREEK RESERVOIRS

PROJECT NO. 15126

April 2016

Figure A-12

1. TOPOGRAPHY DEVELOPED FROM 2-METER DIGITAL ELEVATION MAP BASED ON LIDAR DATA DEVELOPED BY SRI RESEARCH (2002)
2. APPROXIMATE LIMITS OF DISTURBANCE ALSO INCLUDE ALL AREAS BELOW THE MAXIMUM NORMAL RESERVOIR FLOOD AND A BUFFER AROUND THE ROAD RIGHT-OF-WAY
3. CONVEYANCE FACILITIES NOT SHOWN



DRAFT



RJH
CONSULTANTS, INC.

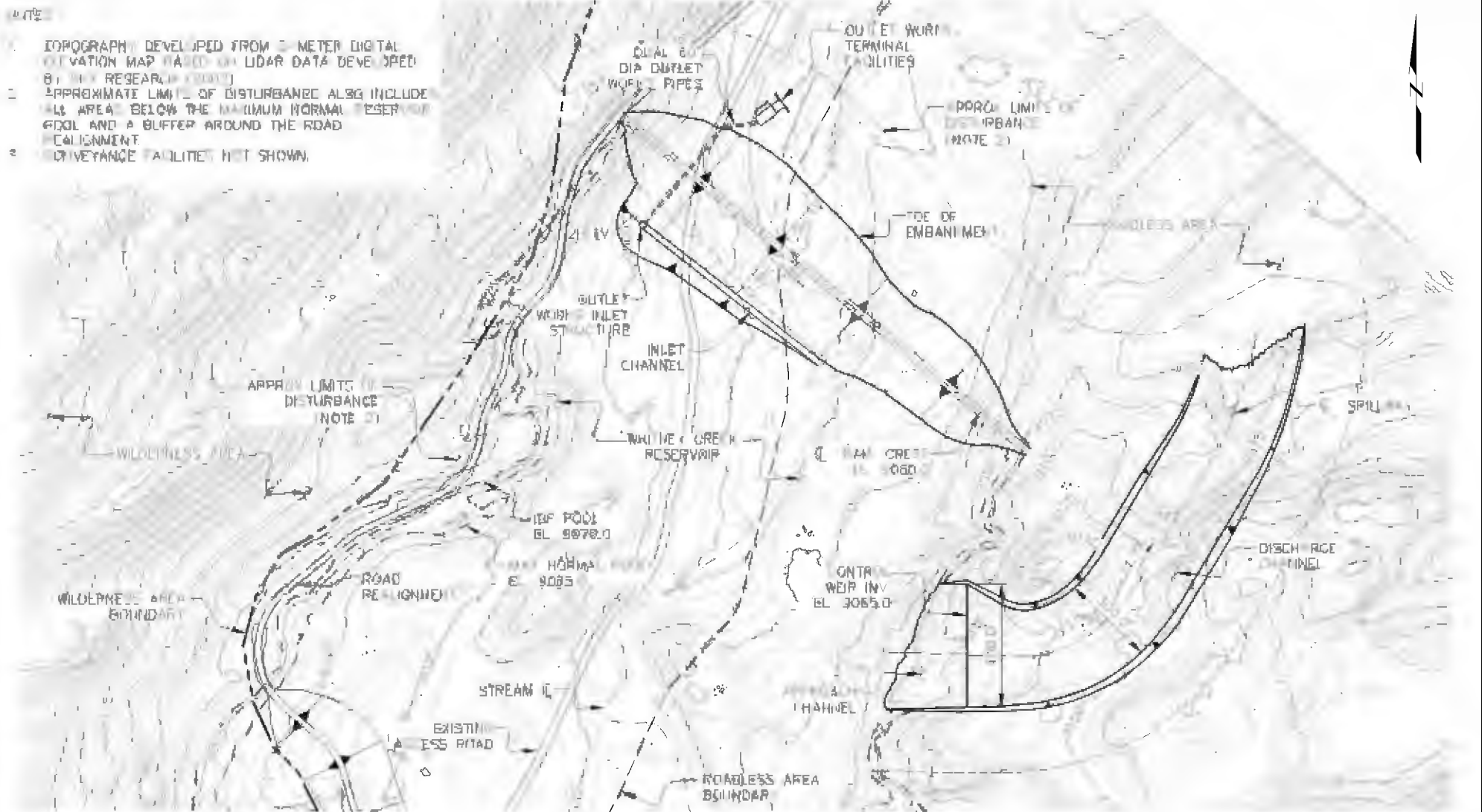
EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

PROJECT NO. 15126

PLAN OF WHITNEY
CREEK DAM -
ALTERNATIVE 1

April 2016

Figure A-13



DRAFT



EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

PROJECT NO. 15126

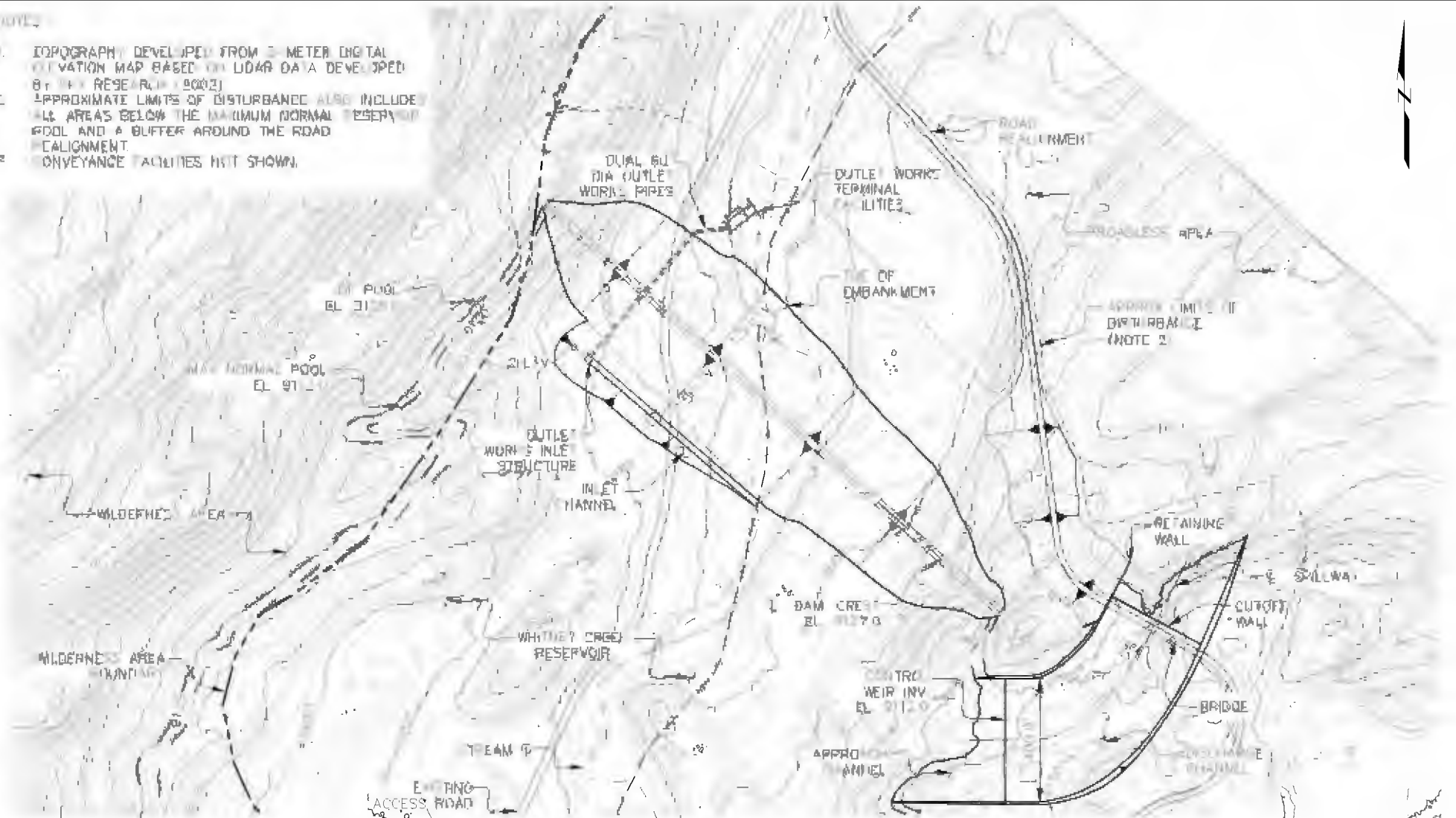
PLAN OF WHITNEY
CREEK DAM -
ALTERNATIVE 2

April 2016

Figure A-14

NOTES:

1. TOPOGRAPHY DEVELOPED FROM 2-METER DIGITAL ELEVATION MAP BASED ON LIDAR DATA DEVELOPED BY THE REGIONAL BOARD (2002).
2. APPROXIMATE LIMITS OF DISTURBANCE ALSO INCLUDE ALL AREAS BELOW THE MAXIMUM NORMAL RESERVOIR POOL AND A BUFFER AROUND THE ROAD ALIGNMENT.
3. CONVEYANCE FACILITIES NOT SHOWN.



DRAFT



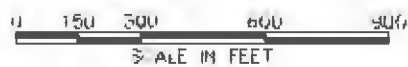
EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

PLAN OF WHITNEY
CREEK DAM -
ALTERNATIVE 3

PROJECT NO. 15126

April 2016

Figure A-15



DRAFT



EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

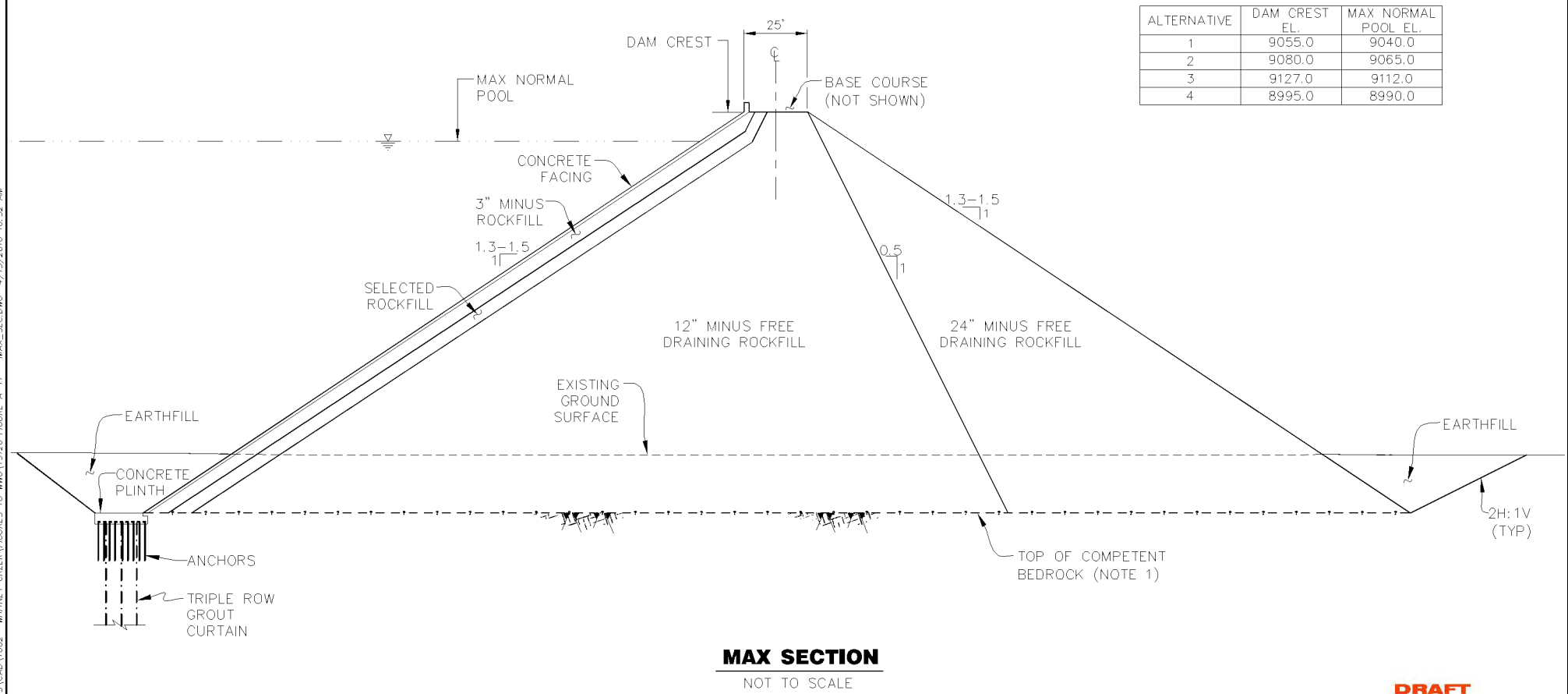
PROJECT NO. 15126

PLAN OF WHITNEY
CREEK DAM -
ALTERNATIVE 4

April 2016

Figure A-16

P:\15126-ERM\04 ALTERNATIVES\CAD\15126-002- WHITNEY CREEK\FIGURES TO MW\15126 FIGURE A-17 - MAX_SECTION.dwg 4/15/2016 10:32 AM



EAGLE RIVER MOU
PROJECT ALTERNATIVES
STUDY - PHASE 2

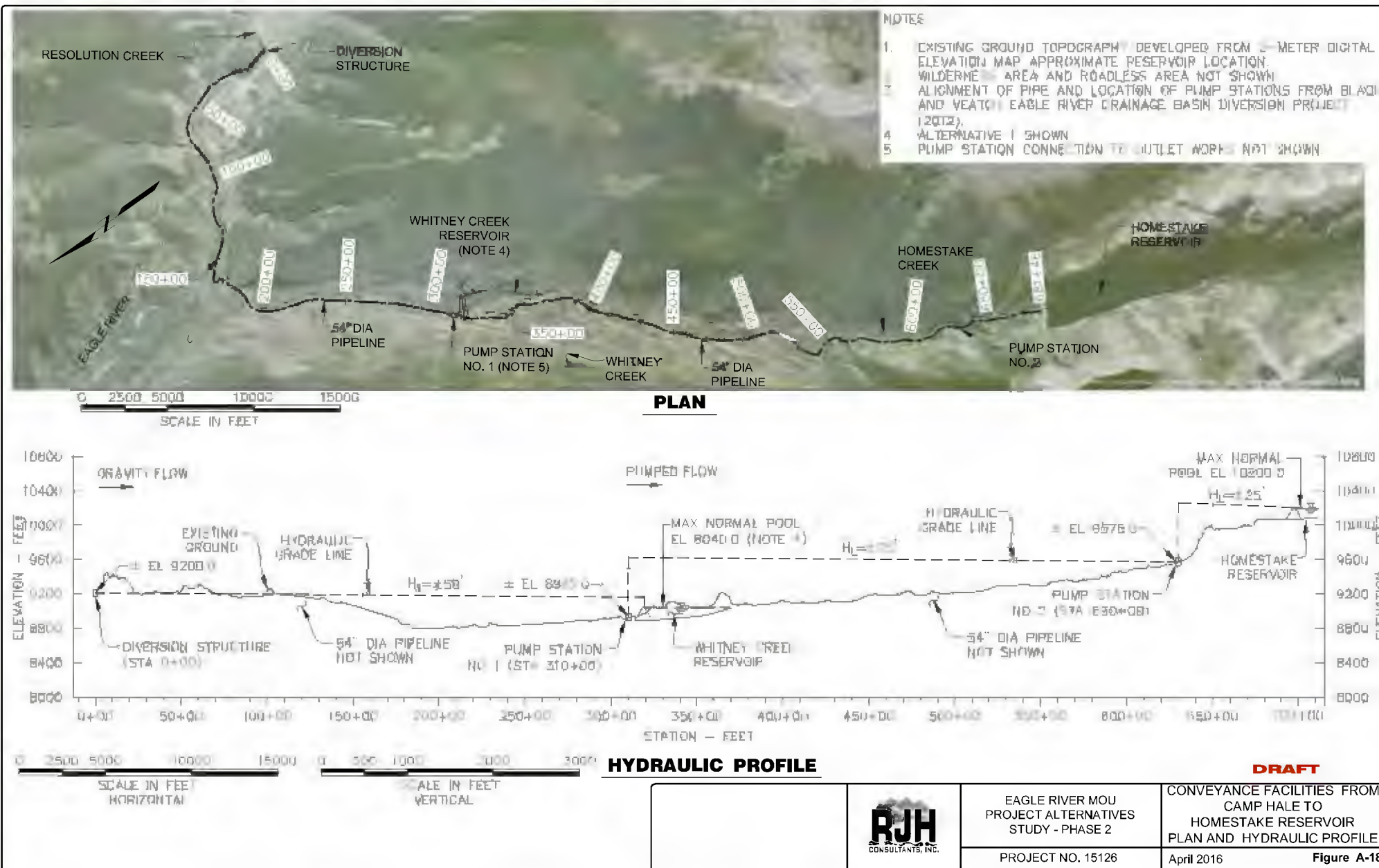
WHITNEY CREEK DAM
TYPICAL SECTION

PROJECT NO. 15126

April 2016

Figure A-17

P:\15126-ERM\01 ALTERNATIVES\CD\1002-WHITNEY_CREEK\FIGURES TO WWC\15126_FIGURE 4-18 - HYDRAULIC SCHEMATIC.DWG 4/15/2016 10:32 AM



P:\15126-ERMOU Alternatives\Engineering\GIS\Figures to WWS\Figure A-19 Camp Hale to Whitney.mxd



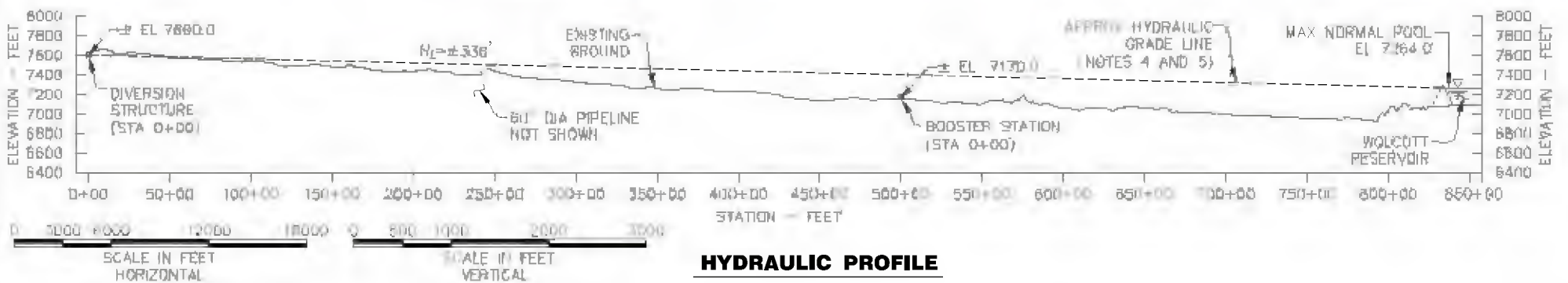
P:\15126-ERMOU Alternatives\Engineering\GIS\Figures to WWG\Figure A-20 Fall Creek and Peterson Tunnel.mxd





P:\15126-ERM\OU Alternatives\Engineering\GIS\Figures to WWS\Figure A-22 Wolcott Res.mxd





NOTES.

1. EXISTING GROUND TOPOGRAPHY DEVELOPED FROM USGS 10-METER DEM
2. ROADLESS AREA ARE NOT SHOWN
3. ALIGNMENT OF PIPE, LOCATION OF BOOSTER STATION, AND HYDRAULIC GRADE LINE FROM WESTERN ENGINEERS, INC DEVELOPMENT WORK FOR THE WOLCOTT AND RED BLUFF PROJECTS REPORT (1988).
4. PUMP STATION CONNECTION TO OUTLET WORKS NOT SHOWN
5. HYDRAULIC GRADE LINE SHOWN FOR GRAVITY FLOW FROM DOWNS JUNCTION TO WOLCOTT RESERVOIR. HYDRAULIC GRADE LINE FOR PRESSURE FLOW FROM WOLCOTT RESERVOIR TO DOWNS JUNCTION NOT PROVIDED IN WESTERN ENGINEERS, INC. REPORT

DRAFT



EAGLE RIVER MOU PROJECT
PROJECT ALTERNATIVES
STUDY - PHASE 2

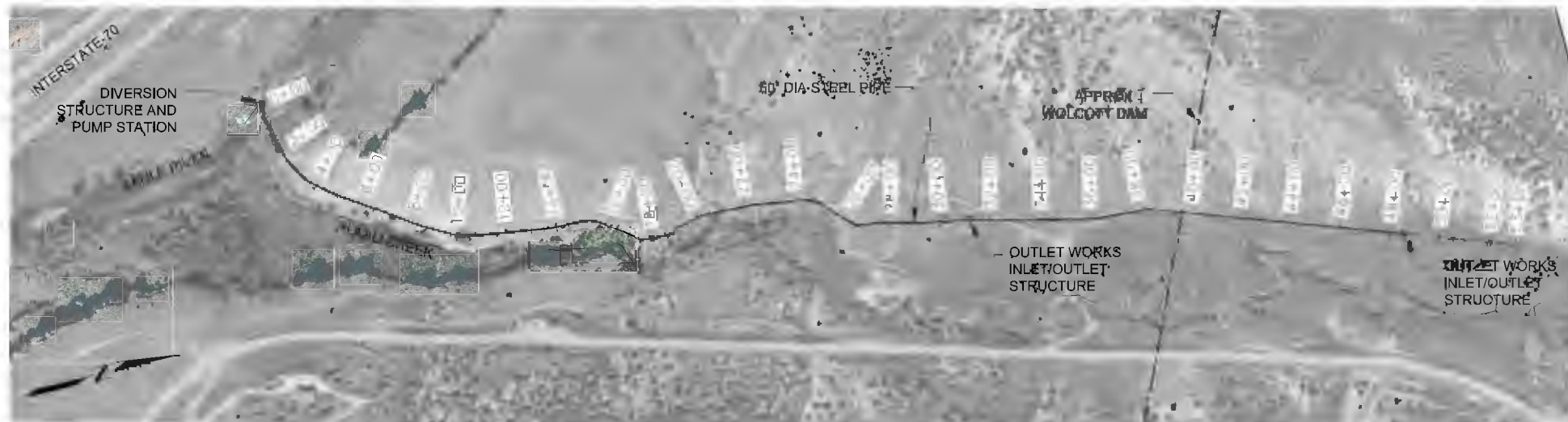
CONVEYANCE FACILITIES FROM
DOWNS JUNCTION TO WOLCOTT
RESERVOIR - PLAN AND
HYDRAULIC PROFILE

PROJECT NO. 15126

April 2016

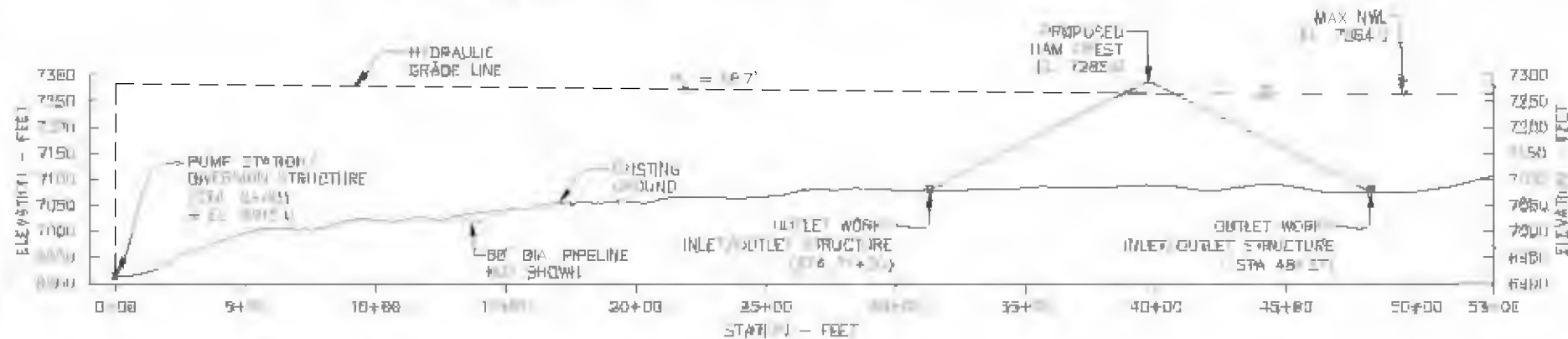
Figure A-23

P:\15126-ERMOU-ALTERNATIVES\CAO\2001-WOLCOTT\FIGURES TO MKS\FIGURE A-24 EAGLE RIVER TO WOLCOTT.DWG J:\15126-ERMOU-ALTERNATIVES\CAO\2001-WOLCOTT\FIGURES TO MKS\FIGURE A-24 EAGLE RIVER TO WOLCOTT.DWG J:\15126-ERMOU-ALTERNATIVES\CAO\2001-WOLCOTT\FIGURES TO MKS\FIGURE A-24 EAGLE RIVER TO WOLCOTT.DWG



0 200 400 600 800 1000
SCALE IN FEET

PLAN



0 100 200 300 400 500 600 700 800 900 1000
SCALE IN FEET
HORIZONTAL

0 100 200 300 400 500 600 700 800 900 1000
SCALE IN FEET
VERTICAL

HYDRAULIC PROFILE

DRAFT

NOTES

- EXISTING GROUND TOPOGRAPHY DEVELOPED FROM 10-METER DEM



EAGLE RIVER MOU PROJECT
PROJECT ALTERNATIVES
STUDY - PHASE 2

PROJECT NO. 15126

CONVEYANCE FACILITIES FROM
EAGLE RIVER TO WOLCOTT
RESERVOIR - PLAN AND
HYDRAULIC PROFILE

April 2016

Figure A-24

Appendix B: Water Supply and Project Yield

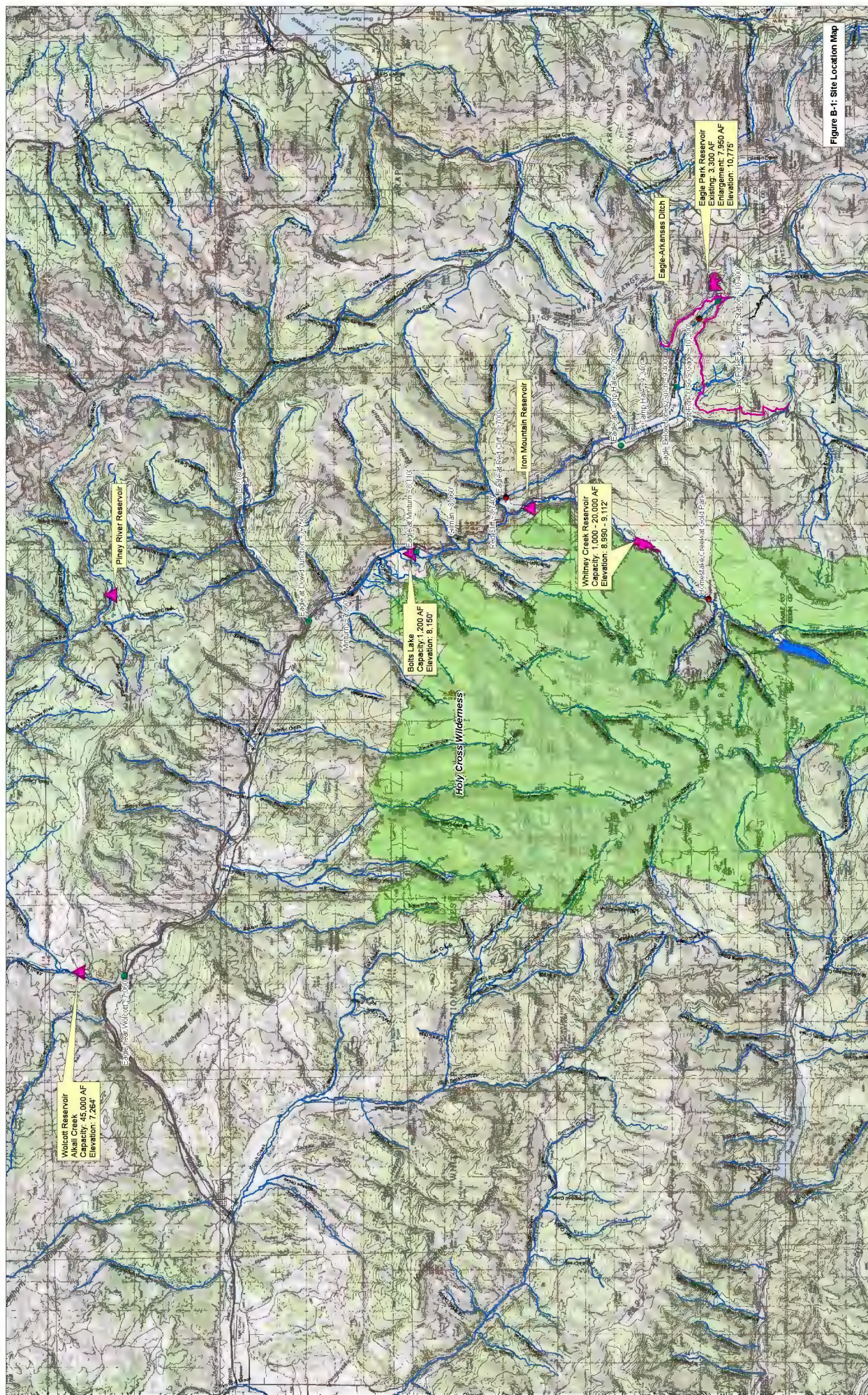


Figure B-1: Site Location Map